An Eye On Reading

John Tassinari (JT), OD, FAAO, Diplomate BVPO
Eric Borsting, OD, MSEd, FAAO, Diplomate BVPO

Disclosures

- John Tassinari
  - None
- Eric Borsting
  - None

Harold Solan

- Dedicate this lecture to an outstanding teacher and researcher.
- Pioneer in the field of vision and reading.

General Approach to Course

Differentiating visual and language components of reading
Diagnostic strategy for saccadic dysfunction
Treatment strategies for saccadic dysfunction
Sample Cases

Common Problem

- Parents often pursue a vision examination for poor reading
- The child frequently complains of loss of place and reads slowly.

Problems in Diagnosis

- All the tests have problems
  - NUSCO
  - DEM
  - Visagraph
- Case history and understanding of reading will help confirm diagnosis
- Identify the child who will benefit from therapy.
Clinical Approach
- Traditionally looked at disorders of accommodation, vergence and eye movements and not reading directly. We hope we get a transfer to reading.
- This course provides a strategy to help you facilitate the transfer and what to expect with reading.

Overview of Reading
- Reading development
  - Understand the reading demands of the child
- Component skills in reading
  - Specific vision and language skills
- Informal evaluation of reading
  - Quick and easy tests to assess reading skills
- Examples

What Makes a Good Reader?
- Be motivated to read a variety of materials.
- Comprehend and learn from reading texts.
- Be able to read words accurately and automatically.

How does reading develop?
- Stages approach proposed by Chall
- Six stages

Stage 1
- Early Literacy and Pre-reading
  - Before Grade 1
  - Awareness of print, phonological awareness, reads common signs, write’s own name

Stage 2
- Decoding
  - Grades 1 and 2
  - Letter sound correspondences, knowledge of the alphabetic principle, identify 1000 common words
Stage 3
- Fluency
  - Grades 2 and 3
  - Integrates skills acquired in stages 1 and 2, reads with greater fluency, can recognize 3000 words

Stage 4
- Uses reading for learning
  - Grades 4 to 8
  - Can use reading as a tool for learning new information, ideas, attitudes, and values.
  - Emphasis in vocabulary development
  - Growth in background knowledge

Stage 5
- Multiple Viewpoints
  - Grades 9-12
  - Ability to read a broad range of complex materials, expository and narrative, from a variety of viewpoints, and a variety of levels of comprehension.

Stage 6
- Construction and reconstruction
  - College of beyond
  - Reading for one’s own needs and purposes.
  - To integrate one’s own knowledge with that of others and create new knowledge.
Component Skills in Reading
- Phonological Awareness
- Alphabetic Principle
  - Phonics
  - Sight words
- Fluency
- Vocabulary
- Comprehension

Skills for Learning to Read
- Phonological Awareness
  - Say cowboy without the boy
  - Say meat with the m sound
- Alphabetic principle or decoding
  - Letter sound correspondence
  - Sight words

Skills for Reading to Learn
- Fluency
- Vocabulary
- Comprehension

Importance of Developing into the Reading to Learn Phase
- The ability to read fluently is very important for the reading to learn stage.
- Children who struggle with reading at the early stages are at an extreme disadvantage in reading.
- Fluency is typically measured in words read per minute.

How Many Words do Children Read?
- A fifth grader reads at 120 words per minute. If the child reads for 60 minutes a day during the week then the child will read 144,000 words a month.
- A fifth grade child reads at 90 words per minute. If the child reads 45 minutes a day during the week then the child will read 81,000 words in a month.
**Reading Debt**
- Children with reading problems tend to have limited practice in reading.
  - Reduced reading rate
  - Reduced time reading
- Cannot build a sufficient sight word vocabulary to effectively reading at grade level.
- A typical 6th grader may read one million words per year.

**Reading Debt**
- Even small improvement in reading fluency and time on task can have a dramatic effect on the amount of words read over time.
- If the child reads 10 more words a minute (90 to 100) for 45 minutes and reads 10 more minutes in a day then you would get an additional 29,000 words a month.

**Diagnostic Strategy**
- Find decoding level
- Is decoding level close to grade level?
- Find fluency level
- Is fluency level close to grade level?

**Determine Decoding Level**
- Single word reading
- Need to determine reading level where decoding is accurate.
- Child will make many errors when reading above his or her decoding level.

**Informal Reading Inventory**
- Determines reading levels for decoding and for comprehension.
- Fluency scores
- Commonly used by reading specialist
- Helpful to use along with the Visagraph/ReadAlyzer

**Reading Levels**
- Independent
  - Reading without guidance from the teacher
- Instructional
  - Read with guidance
- Frustration
  - Reading material too difficult
Levels of Reading

- Decoding level
  - Independent
    - 95 to 100%
  - Instructional
    - 90 to 95%
  - Frustration
    - Less than 90%

- Comprehension level
  - Independent
    - 90-100%
  - Instructional
    - 70-90%
  - Frustration
    - Less than 70%

Using IRI Levels

- Helps with picking grade level of passage
- Want child to make few decoding type of errors.
- IRI is time consuming to do.
- Use a curriculum based measurement approach.

Curriculum Based Measurement

- Is used to measure growth in a particular skill.
- Most common is 1 minute reading in context of grade level material.
- Number of words read correctly.
- Are they reading at grade level?

Testing for Decoding Level-Word Lists

- San Diego Quick Assessment
  - 10 words per grade
  - [www.nifl.gov/readingprofiles/SD_List_Pop.htm](http://www.nifl.gov/readingprofiles/SD_List_Pop.htm)
  - Highest grade level where you get 9 out of 10 words correct.

Word List

<table>
<thead>
<tr>
<th>city</th>
<th>middle</th>
<th>moment</th>
<th>frightened</th>
</tr>
</thead>
<tbody>
<tr>
<td>exclaim</td>
<td>several</td>
<td>lonely</td>
<td>drew</td>
</tr>
<tr>
<td>since</td>
<td>straight</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SDQA Scoring Form

<table>
<thead>
<tr>
<th>Passage</th>
<th>Fluency</th>
<th>Palant</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy CBM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dibels</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIMSweb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visagraph/readalyzer passages</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graded passages</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Found at San Diego Quick Assessment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use corresponding grade level passage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Produce reading rate or words per minute</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reading Passages

- Find decoding level with San Diego Quick Assessment.
- Use corresponding grade level passage
- Visagraph/readalyzer passages
- Graded passages
  - EasyCBM
  - Dibels
  - AIMSweb
- Patient reads for one minute

Evaluating Passage Reading

- Is the child reading at instructional reading level?
  - No more than 10 percent decoding errors
- Reading rate or words per minute

Student Copy

Susan was nervous because it was her first day attending a new school. She had just moved from a different state. She did not know anybody at her new school. She was worried that the kids would be mean to her. Both her mother and father had started new jobs, so Susan had to ride the bus to school on her own that first day. This made her even more nervous. As Susan was waiting for the bus, another girl about her age walked up to the bus stop too. She said her name was Karen. She asked if Susan was going to River Park School. Susan told her that she was starting school there that day.

Oral Reading Rate Norms

- Fall, Winter, and Spring
- Percentiles
Third Grade

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>10th</td>
<td>21</td>
<td>36</td>
</tr>
<tr>
<td>25th</td>
<td>44</td>
<td>62</td>
</tr>
<tr>
<td>50th</td>
<td>71</td>
<td>92</td>
</tr>
<tr>
<td>75th</td>
<td>99</td>
<td>120</td>
</tr>
<tr>
<td>90th</td>
<td>126</td>
<td>146</td>
</tr>
</tbody>
</table>

Oral Reading Rate Norms

<table>
<thead>
<tr>
<th>Grade</th>
<th>Reading Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23 wpm</td>
</tr>
<tr>
<td>2</td>
<td>72 wpm</td>
</tr>
<tr>
<td>3</td>
<td>92 wpm</td>
</tr>
<tr>
<td>4</td>
<td>112 wpm</td>
</tr>
<tr>
<td>5</td>
<td>127 wpm</td>
</tr>
<tr>
<td>6</td>
<td>140 wpm</td>
</tr>
</tbody>
</table>

Reading Rate Examples

- Need to read more than 100 words per minute
- Example

Miscue Analysis

- Skipping a line: The subject does not read a whole line.
- Omitting a word: The subject does not read a word or phrase with no self-correction.
Miscue Analysis

- **Repetition**: The subject repeats a word, sentence, or phrase.
- **Addition**: The subject adds a word to the text with no self-correction.
  - John is a (really neat and) good boy
- **Mispronunciation**: The subject mispronounces a word or phrase with no self-correction.
  - John is a good (great) (goob) boy

Miscue Analysis

- **5-Second Pause**: The subject is silent. No verbal effort is attempted to read word. After a 5-second pause, the administrator tells the subject the word.
- **10-Second Decoding**: The subject takes 10 seconds attempting to sound out and annunciate a word. If word is incorrectly pronounced after 10-seconds, the administrator tells the subject the correct annunciation.
- **Self-correction**: The subject self-corrects any error(s) made. If the subject makes additional errors (such as a repetition or omission) within the self-correction error, only one error is marked. Example: "A m-m-man...man out of the car...A man got out of the car."

Diagnostic Strategy

- **San Diego Quick Assessment**
  - Highest level with at least 9 out of 10 correct
- **CBM passage**
  - > 90% of words read correctly
  - Few pauses or decoding attempts

Examples

- **3rd grade female with an IEP**
- **San Diego Quick Assessment at grade 1**
- **CBM at grade 1 shows 7 errors for 73 words read in 1 minute**
- **Most errors are mispronounced words**
- **Primary decoding problem**
- **Has OMD**

Examples

- **5th grade male**
- **San Diego Quick Assessment at 4th grade**
- **CBM at grade 4 shows 105 words read with 4 errors. Tends to have repetition errors.**
- **Poor fluency**
- **Has CI and OMD**

Oral Reading Rate Norms

<table>
<thead>
<tr>
<th>Grade</th>
<th>Rate (wpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>23</td>
</tr>
<tr>
<td>Grade 2</td>
<td>72</td>
</tr>
<tr>
<td>Grade 3</td>
<td>92</td>
</tr>
<tr>
<td>Grade 4</td>
<td>112</td>
</tr>
<tr>
<td>Grade 5</td>
<td>127</td>
</tr>
<tr>
<td>Grade 6</td>
<td>140</td>
</tr>
</tbody>
</table>
Oculomotor Dysfunction (OMD)

• Definition: A deficiency in the skills used to execute accurate fixation, saccadic, and pursuit eye movements.
• Diagnosis: Case History + Clinical Testing
• Treatment: VT

Case Report. LK, 3rd Grade Age 8;10

• Behind in reading. Difficulty keeping place while reading is a prominent concern. Dislikes reading
• Teacher and parent both noted OMD symptoms
• Low scores on NSUCO Saccade test
• DEM: Low Ratio & Errors score
• Diagnosis: OMD

Reading Saccades

• Visually guided fine motor action. Visual guidance is from peripheral information
• Fast: 400-600 deg/sec. 30msec duration.
• Saccade spatial parameters: direction and length
• Saccade accuracy
• Fixation pause duration: 250msec (+/-)
• Fixation pause intake: 5-8 characters from central plus 0-10 from periphery
Saccade Event

• Saccade: 8 characters (including space) from 1 optimal landing site to next. The saccade is very fast and ballistic

• Optimal landing site: the letter just left of center of a word. Foveate here for more efficient decoding

Saccade Event (cont)

During Saccade…

1. Suppress visual input

2. Magnocellular Pathway inhibits Parvocellular Pathway to prevent “visible persistence” from interfering with next fixation.

3. Possibility of vergence or accommodative error

Fixation Pause Contents

• What now: Extract info from the 5-8 characters in central vision.

• What next preview: extract info from text in peripheral vision to prime decoding of next fixation, and, analyze peripheral text for spaces, word length, punctuation and capital letters to aid…

• Where next: how far? Can I hit an optimal landing site? Activate sacc motor plan

Fixation Pause (+/- 250 msec)

← (attention) →

1 2 3 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 5 5 5 5 5 5 5 6 6 7

1. Eyes land / Saccade ends
2. Accom/Verg status
3. Recall + pattern recognition
4. DECODE
5. Glean periphery: preview, motor plan, visual memory, GO
6. Saccade suppress begins (M-on, P-off)
7. Eyes launch

Fixation Pause (350msec)

← (attention) →

1 2 3 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 5 5 5 6 6 7

1. Eyes land / Saccade ends
2. Accom/Verg status
3. Recall + pattern recognition
4. Decode with difficulty
5. Glean periphery (compromised)
6. Saccade suppress begins
7. Eyes launch: next saccade inefficient

OMD Diagnosis

• Case Hx
   (1) OMD symptoms
   (2) Assess severity of symptoms
   (3) Other reports for conditions that can mimic OMD

• Direct testing/screening by OD for OMD mimickers (DDT, TAAS, SDQA)

• Testing for OMD
OMD Diagnosis: Case History

ELICIT SYMPTOMS
1. Questionnaire to parents
2. Questionnaire to teacher(s)
3. Direct Q & A - patient
4. Direct Q & A – parent
5. Direct observation while testing

OMD SYMPTOMS
1. Dominant symptom is difficulty keeping place while reading or copying (DKP)
2. DKP includes loss of place, skipping words, skipping entire lines of text, and unintentional re-reading of lines of text
3. Over-reliant on a place-keeper
4. Excessive head movements

Other Causes of DKP
1. Poor / slow decoding
2. Lapse in attention
3. Re-read for comprehension
4. Binoc/accomm dysfunction
5. Low Level Processing Deficits

Severity of DKP Symptom

OMD PLUS
- Severe DKP
- Reading is Very Slow
- Fluency Concerns

OMD Only
- Mild-moderate DKP
- Minor-moderate

OMD Symptoms: Young K – early 2nd (stages 1 & 2, not yet fluent reading)
- Confusion with change in fixation (worksheets)
- Ball catching difficult

If youngster has true symptomatic OMD it is often coincident with motor problems and visual perceptual problems including and especially deficient VMI/poor printing.

This combination has been called ‘Developmental OMD’ (see Applied Concepts in Vision Therapy)

OMD Symptoms - Emerging readers. Mid 2nd – 5th (stage 3, Fluency begins, & early stage 4)
- Classic presentation of DKP if child has OMD
- Loses place
- Skips words and lines
- Unintentional re-reading of lines
- Over-reliant on place-keeper
- Copying: errors and/or slowness
  - Home: book-to-paper copying
  - School: board-to-desk
- Head movements / moves close
OMD Symptoms – middle school and older (stages 4+, 5 and 6)

- Unintentional re-reading
- Skips entire lines of text but can self correct
- Skips words: less frequent than younger much
- Slow reading rate
- Copying slow; test taking / scan tron

OMD Testing

- Observational Tests
- Search and Scan Timed Psychometric Paper Tests. Simulate saccade demand while reading.
- Recording of eye movements with goggles
- Oral Reading

OMD Testing Pitfalls

- Reliability: repeatability
- Validity: Does test measure eye movement control as it used in actual reading and copying
- Multiple influences on present testing methods.
- Case History and understanding of reading stages are mandatory

Indisputable True State of Saccadic Skill

<table>
<thead>
<tr>
<th>GOOD</th>
<th>BAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>(X)</td>
</tr>
</tbody>
</table>

Test Result: + : Test Result = truth  X : bad data

Clinical Testing- Observational Tests

- NSUCO (Maples) Oculomotor
  1) age-normed
  2) OU (only)
- SCCO 4+ system
  1) monoc & binoc
  2) fixations, saccades, and pursuits

NSUCO Oculomotor Test

Saccades: child alternately looks at 2 targets 20cm apart. 5 round trips (10 saccades total)

Pursuits: child pursues target moving in a 20cm diameter circle. 4 circles total. 2ccw 2cw

Child stands. Targets at normal reading distance (Harmon distance)
NSUCO Oculomotor Test (cont.)
Examiner: rate 4 test elements on a scale of 1 (low) to 5 (high)
1. Judge ability to complete test
2. Observe body movement
3. Observe head movements. Determine if gross or slight and count
4. Scrutinize for errors. Determine if gross or slight and count.
Applies to Saccade and Pursuit test

Administration Tips
• Playful youngsters
• Are we there yet?
• Impulsivity. “waiting is the hardest part”.
• Don’t score obvious attention lapse
• Head Movement interpretation

NSUCO Saccade Accuracy Score: 1 - 5
Error = under or over shoot

- No errors: score = 5 all ages pass
- Gross error(s): score = 1 or 2, all ages fail

- Slight errors:
  1-4 slight errors: score = 4, all ages pass
  5-10 slight errors: score = 3
  Accuracy score = 3, age 5 – 7;11 PASS
  Accuracy score = 3, age ≥ 8;0 FAIL

NSUCO. Scoring Head Movement
Saccade or Pursuit. Score = 1-5

Gross (score = 1-2) Fail None (score=5) Pass
Slight HMs If slight, count HMs
  1 – 4 score = 4 = pass all ages
  ≥ 5 HMs, score = 3
HM Score of 3…
  Age 5 - 7;11 → Pass
  Age 8 - 8;11 → Borderline
  ≥ 9;0 → Fail

NSUCO Pursuit Accuracy Score. Count errors. Error = loss of pursuit then refixate

<table>
<thead>
<tr>
<th>Errors</th>
<th>Score</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>Pass (all ages)</td>
</tr>
<tr>
<td>1-2</td>
<td>4</td>
<td>Pass (all ages)</td>
</tr>
</tbody>
</table>
| 3-4    | 3     | Pass age 5-7;11 Pass
  Fail, age ≥ 8;0 Fail
| 5-10   | 2     | Fail (all ages) |
| >10    | 1     | Fail (all ages) |

NSUCO Oculomotor Test Analysis of Results

• Fail Sacc and/or Purs (and fail DEM) = moderate to marked OMD

• Pass NSUCO – OMD not ruled out

• 3rd grader or older with a score of 3 or lower is usually very symptomatic and a good VT case.
Visual Tracing Test (VTT)
- Useful ‘Niche’ test for mid-K – early 2nd who can not do DEM.
- Non-verbal. Timed test. VFG demand
- Not well researched
- Observations very helpful

Clinical Testing-K. Devick
- Demonstration + 3 Test Plates.
- Test Plate #1: Niche Test for 1st graders or very low functioning older children
- Visual-verbal format. Timed test.
- 6 cm wider than DEM and typical book (more head movements)

Clinical Testing – Developmental Eye Movement Test (DEM)
- Visual-Verbal format, timed test
- Simulates saccade demand while reading
- Vertical Test measures Rapid Automatized Naming
- Ratio factors out RAN
- Grades 1 - 8

DEM Administration & Scoring
- Complete Vertical Subtest (test A and B). Record time
- Complete Horizontal Subtest (test C). Record time and errors
- Calculate Ratio. Ratio = H ÷ V
- Convert Raw Scores to %ile rank
- Low ratio (close to 1.00) = good score

Scoring Example. Lachlan 3rd Grade
- DEM Vertical RS = Test A + Test B
  21 sec + 19 sec = 40s = 65th percentile
- DEM H = 53 seconds with 5 omission errors. 5 errors = 12th percentile
- Adjusted time = 56.5 sec
- Ratio = 56.5 ÷ 40 = 1.40 = 15th percentile

DEM Administration Tips
- Patient holds book
- Demonstrate left-to-right and return sweep
- Emphasize speed element
- Emphasize no finger or thumb to help
- Parent observes
DEM – key observations

- Head movements
- Moves close
- Attempts to use finger or thumb
- Hesitations on vertical subtest
- Return sweep spatial confusion
- Obvious struggle with large saccades

DEM Analysis of Results

- Low Ratio Score supports OMD Dx
- Low Vertical score = deficiency in Rapid Automatized Naming
- Low Ratio with good Vertical
- Low Ratio with Low Vertical

Eye Movement Recording with Goggles

- Visagraph / Readalyzer
- Very sensitive to fixation duration / slow decoding
- Brief attention lapses skew results
- Normal fixation duration with excessive fixations and regressions consistent w OMD

Diagnostic Strategy – Young K – mid 2nd

- Case History: worksheets + Motor/VMI
- NSUCO Oculomotor Test
- Visual Tracing Test
- K Devick 1 sometimes
- DEM sometimes

Diagnostic Strategy Emerging Reader (mid-2nd – 5th)

- Case Hx – DKP, copying
- DEM
- NSUCO Oculomotor Test
- Informal Reading assessment
- Visagraph - sometimes

Diagnostic Strategy – Middle School and Older

- Case Hx
- DEM
- Informal Reading Assessment
- Visagraph
## OMD Diagnostic Criteria
- **Low Test Scores:** 17th – 30th percentile
  - Symptoms?
  - **NO. - OMD**
  - **YES. + OMD**
- **Really Low Test Scores:** 1st – 16th percentile - - - +OMD

## VT for OMD
- Lenses first
- Treat Accommodative and Vergence dysfunction first or simultaneously
- VT emphasizing pursuits & saccades simultaneously
- OMD + Young + VP Motor deficits...
  - Developmental VPM VT first or simultaneously

## VT Emphasizing Saccades
- **Peripheral Awareness Foundation**
- Gross saccades » Fine
- Simple figure ground » complex FG
- Spatial challenge easy » difficult
- Speed demand absent » present

## VT: Peripheral Awareness
- Steady fixation. Saccade not needed.
- Saccade will detract from performance
- Example: Track & Read Computer Program (available from Bernell), Span of Recognition

## VT. Gross to Fine
- Gross: Big Targets with large spacing
- Fine: Small targets close together
- Example: Michigan Tracking Workbooks

## VT. Figure Ground Simple » Complex
- Simple FG: Training targets have little or no surrounding targets (uncluttered background)
- Complex FG: Training targets embedded within many other targets
- Example: Percon Saccade Workbook 2 (simple FG) vs Percon Sacc WB 3 (complex FG).
VT. Spatial Challenge
Easy » Difficult

Where to look next decision can be made easy or difficult with spacing (regular or irregular) and straight line versus diagonal.

Example: Letter strip tracking. Landmarks (colored underline) aid the spatial decision. Placement of strips raises/lowers spatial challenge.

VT. Add Speed

- If saccade error, miss target. Ex. Flash Card Selective Looking
- Track & Read Program, Tracking Sequences

Gross Saccade VT
Developmental OMD

- Youngsters with D OMD often struggle with vision leads motor including peripheral vision leads the motor act of saccade
- VT Procedure ‘Picture Search’ exaggerates and slows down the peripheral vision based motor plan of a saccade

Additional References


Additional References

- Ciuffreda KJ, Tannen B. Eye Movement Basics for the Clinician St. Louis 1995 Mosby